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Reference Mass

[Gaziray Project]

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1 SUBJECT

The purpose of this document is to provide the mass budget of the EMU.

2 TECHNICAL REQUIREMENT DOCUMENT

2.1 Applicable Documents

Rif.	N.° Document	Version	Description
[1]	IDB-UTP-GAZ-G01_8 EMU TECNICAL SPECIFICATION -	22.06.2020	Technical requirements
[2]	EN 15663	2017+A1:2018	Railway applications - Definition of vehicle reference masses

2.2 Reference Documents

Rif.	N.° Document	Description
[1]	TŞ-01 139	Gaziray Commuter Train - General Technical Specification
[2]	GZ90.00.00.00101	General Layout

3 GENERAL REQUIREMENTS

The mass budget is defined according to the following requirements derived from A.D.[1] and A.D:[2].

3.1 LOADING CONDITIONS

The loading conditions required by A.D. [1] are summarized in the following table.

LOAD CONDITION	ID	Cycle Rate in Operation
Empty	AW0	2%
sitting passengers (including the driver)	AW1	8%
sitting passengers + 4 standing per square meter	AW2	40%
sitting passengers + 6 standing per square meter	AW3	48%
sitting passengers + 8 standing per square meter	AW4	2%

Table 1 – EMU Loading Conditions

The reference masses will be defined considering the following passenger occupancy defined in A.D:[1].

OCCUPANCY CONDITION	ID	Cycle Rate in Operation
Normal	AW2	4 standing per square meter
Excessive	AW3	6 standing per square meter

Table 2 – Occupancy Data

3.2 VEHICLE REFERENCE MASSES

The reference masses are defined in the following, according to A.D.[2]. They are defined in order to be used for specifying the requirements of EMU design.

The vehicle category is M-II in accordance to par. 4.2 of A.D:[1].

The reference Masses defined in the present document are:

Reference Mass	Acronym	Definition
Dead mass	MU	Vehicle in the “as built” condition without consumables and without staff
Design mass in working order	MVD	$MVD = MU + PCD$
Design mass in normal payload	MND	$MND = MVD + PND$
Design mass under exceptional payload	MXD	$MXD = MVD + PXD$

Table 3 – Reference Masses

Where the payloads are defined as follows:

Reference Payloads	Acronym	Definition	
Payload consumables design	PCD	Staff mass:	80 kg pp
		Fuel	Maximum design quantity
		Sand	
		Windscreen washer fluid	
		Unlisted consumables	
		Wear allowance	No
Payload normal design	PND	Passenger mass:	70 kg pp
		Seated Passengers	100%
		Standing Passengers	4 pp square meter
		Folded seat	According to operator
		Luggage area	100 kg/m ² for surface
Payload exceptional design	PXD	Passenger mass:	70 kg pp
		Seated Passengers	100%
		Standing Passengers	6 pp square meter
		Folded seat	According to operator
		Luggage area	100 kg/m ² for surface

Table 4 – Reference Payloads

3.3 REFERENCE MASSES CORRELATION

REFERENCE MASS	EN 15663	GBB	Deviations
Dead mass	MU	-	Not defined in GBB
Design mass in working order	MVD	AW0	
Design mass in normal payload	MND	AW2	Person mass, luggage
Design mass under exceptional payload	MXD	AW3	Person mass, luggage

Table 5 –Reference Masses/Loads Correlation

The AW0 mass is considered to include the staff and consumables in order to be comparable with MVD mass.

The reference mass MND is considered to correspond to AW2 for number of passengers, according to par. 3.1.

The reference mass MXD is considered to correspond to AW3 for number of passengers, according to par. 3.1.

4 VEHICLE MAIN DATA

The mass budget is defined according to the design of the EMU. In particular the following table summarizes the principal dimensions of the EMU:

ITEM	DIMENSION [mm]
rain set length over coupler	96000
SKA length over couplers	24720
OA length over couplers	23280
Total width	2950
Roof height of car body from top of rail	3770
Total height over equipment (above rail level)	4400
Coupler height in cab ends (above rail level)	1040
Coupler height in intermediate ends (above rail level)	775
Wheel Diameter (new/worn)	840 / 770
Bogie centre distance	16000
Track gauge	1435

Table 6 – Train set main dimensions EMU

The EMU internal arrangement and external equipment lay out is depicted in R.D. [2].

In particular the distribution of the main components on the EMU cars is depicted in the following table.

Component	SKA	OA	OA	SKA
Roof Mounted Equipment				
Cabin HVAC	1			1
Passenger HVAC	2	2	2	2
Pantograph + HV related devices		1	1	
Air Production		1	1	
Auxiliary Air Production		1	1	
Brake Resistor	2			2
Under Frame Mounted Equipment				
Traction Converter	1			1
Brake Package (EPC+Distributor)	1	1	1	1
Battery Box		1	1	
Auxiliary Converter		1	1	
Main transformer		1	1	

Table 7 – EMU main components distribution

For what concern the EMU sitting capacity, it is summarised in the following table.

Passengers			
Description	Head Car (SKA)	Intermediate Car (OA)	Trainset
Passengers Seats	46	57	206
Wheelchair Seats	1	-	2
Standing Area	31,7	34,5	132,4
Standing Passengers	190	207	794
Total Passengers	236	264	1000

Note: 3 folding seats are available in SKA if the PRM area is not occupied by the wheelchair

Table 8 – EMU passenger capacity

5 REFERENCE MASS

The reference masses to be applied for design are defined in the following.

Bogie	Mass	Total	SKA	OA
Motor Type 1	8600	2	1	-
Motor Type 2	8500	2	1	-
Trailer Type 1	6000	2	-	1
Trailer Type 2	6000	2	-	1

Table 9 – Bogie Masses (Kg) with EN payloads mass

Load Case	Total Mass (Kg)	SKA1 Front	OA1	OA2	SKA1 Rear
AW0 - empty car (MWD)	189758	49882	44963	45033	49882
AW1 - seated passengers only	204178	53102	48953	49023	53102
AW2 - 4ppm2 (MND)	241250	61978	58613	58683	61978
AW3 - 6ppm2 (MXD)	259786	66416	63443	63513	66416
AW4 - 8ppm2	278322	70854	68273	68343	70854

Table 10 – Car and Trainset Masses (Kg) with EN payloads mass

Load Case	Load Case (Payload according to EN 15663)	SKA Front Bogie	SKA Rear Bogie	OA1 Front Bogie	OA1 Rear Bogie	OA2 Front Bogie	OA2 Rear Bogie
AW0	MVD	13538	11403	11258	11224	11291	11226
AW1	-	14089	12462	12187	12289	12219	12292
AW2	MND	16055	14934	14655	14651	14688	14654
AW3	MXD	17038	16169	15889	15832	15922	15835
AW4		18022	17405	17123	17014	17156	17016

Table 11 – Axle Loads (Kg) with EN payloads mass

Load Case (Payload according GBB)	Load Case (EN 15663)	Trainset Average Bogie Load (Kg)
AW0 - empty car	MWD	11860
AW1 - seated passengers only		12761
AW2 - 4ppm2	MND	15078
AW3 - 6ppm2	MXD	16237
AW4 - 8ppm2		17395

Table 12 – Average axle load (Kg)

Secondary	SKA1		OA1		OA2	
	Front Motor Bogie Type1	Rear Motor Bogie Type2	Front Trailer Bogie Type1	Rear Trailer Bogie Type2	Front Trailer Bogie Type1	Rear Trailer Bogie Type2
AW0 - empty car (MWD)	18476	14306	16515	16447	16581	16452
AW1 - seated passengers only	19577	16424	18374	18579	18439	18584
AW2 - 4ppm2 (MND)	23510	21368	23310	23303	23375	23307
AW3 - 6ppm2 (MXD)	25477	23839	25778	25665	25844	25669
AW4 - 8ppm2	27444	26310	28246	28027	28311	28031

Table 13 – Secondaries Loads(Kg) with EN payloads mass

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